Building Java Programs

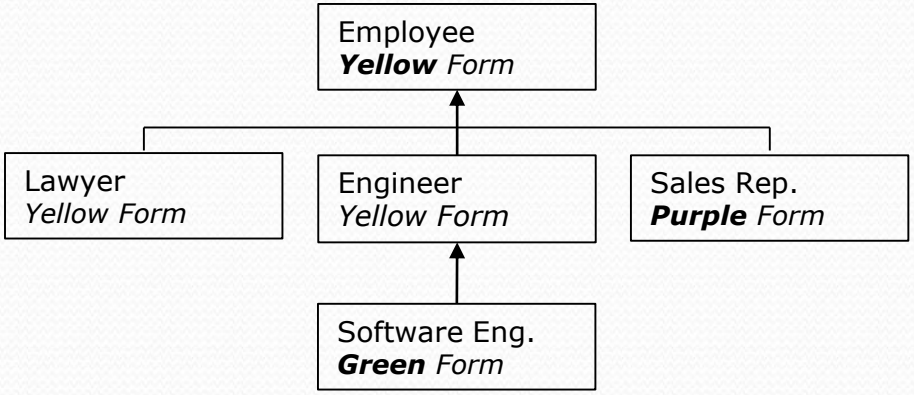
Chapter 9
Inheritance and Polymorphism

reading: 9.1 - 9.2


PRO PLAN

Recall: Inheritance

- **inheritance**: Forming new classes based on existing ones.
  - a way to share/**reuse code** between two or more classes
  - **superclass**: Parent class being extended.
  - **subclass**: Child class that inherits behavior from superclass.
    - gets a copy of every field and method from superclass
  - **is-a relationship**: Each object of the subclass also "is a(n)" object of the superclass and can be treated as one.



```
public class A {
  public void m1() {
    m2();
    S.o.pln("A1");
  }

  public void m2() {
    S.o.pln("A2");
  }
}

public class B extends A {
  public void m2() {
    S.o.pln("B2");
  }
}
```

Poll Everywhere

```
B b = new B();
b.m1();
```

What is the output?

- A2 / A1
- B2 / A1
- Some kind of error
- I'm not sure

Why cover this again?

- New Topics
  - More practice with understanding polymorphism
  - Investigating Java's type system
    - What happens when you using casting with objects?
    - What is and isn't possible for the compiler to check?
- Motivation: We've been hand-waving what it means to say

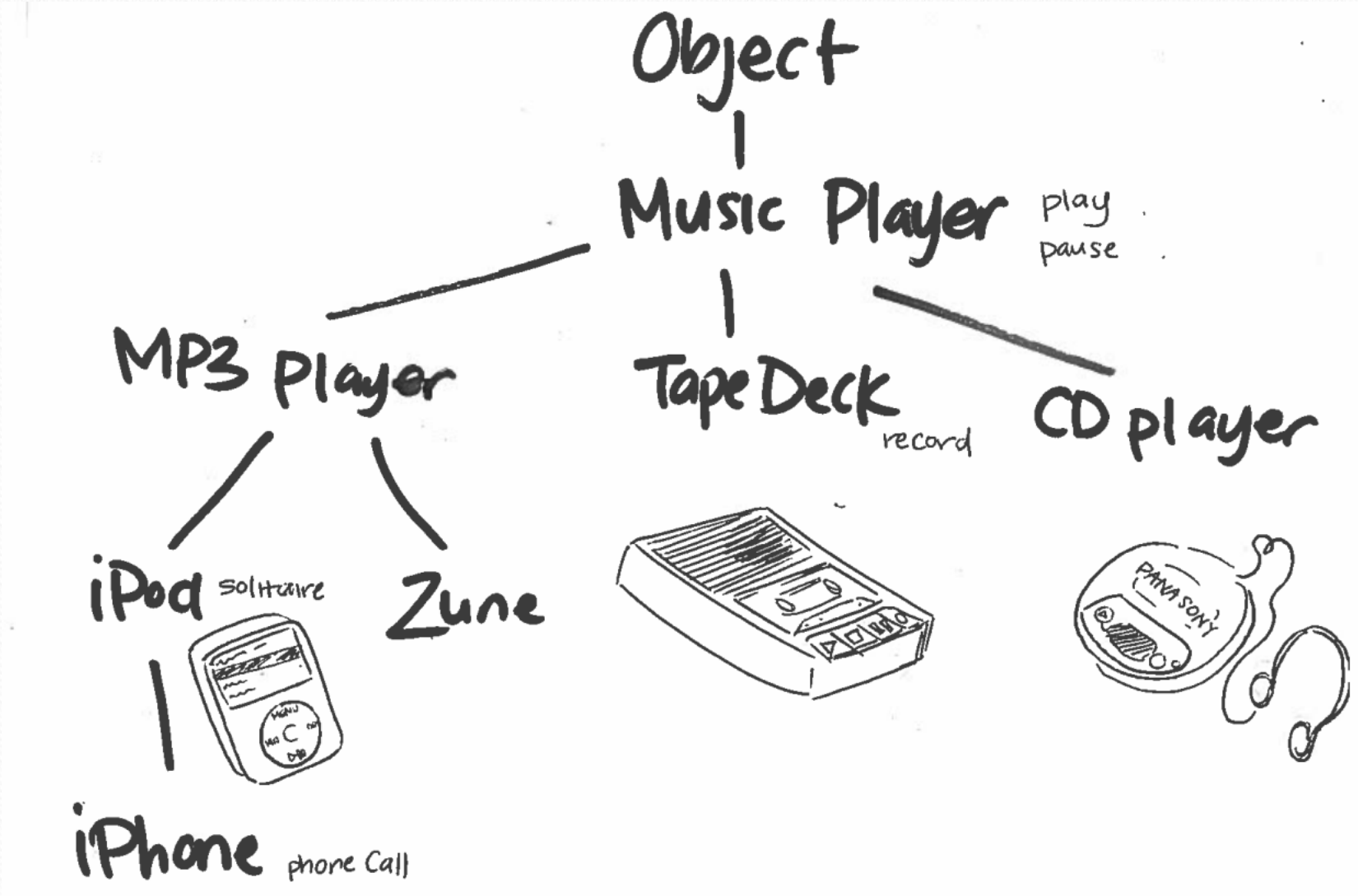
```
List<Integer> list = new ArrayList<Integer>();
list.add(1);
```

- Why allow different types on the left side vs. right side?

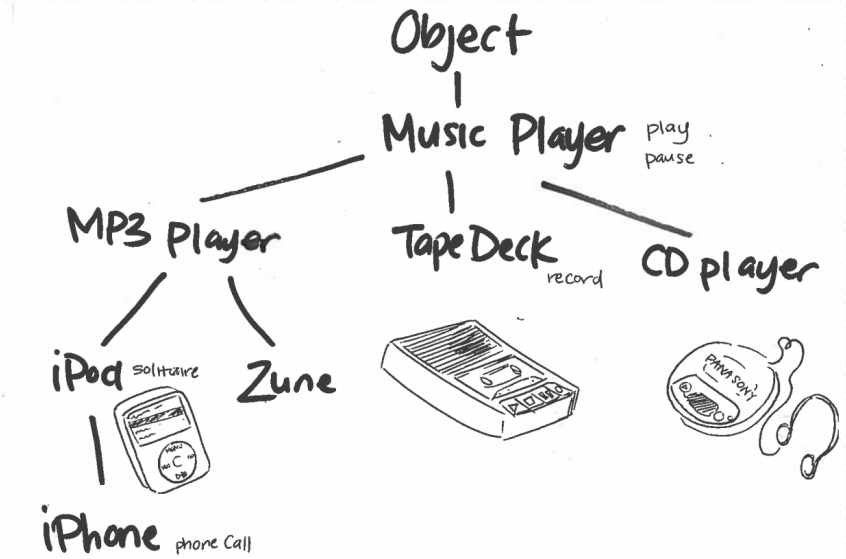
```
PromiseType variable = new ActualType();
```

- `PromiseType` can be a super-type that `ActualType` extends or an interface that `ActualType` implements
  - Restricts usage of the instance of `ActualType` to only `PromiseType` methods. Why is this useful?

Example: Music Players



Poll Everywhere




```
MusicPlayer p3 = new Zune();

((iPhone) p3).record();
```

What does this line do?

- Call record on Zune
- Call record on MusicPlayer
- Call record on iPhone
- Compiler Error
- Runtime Error

```
public class MusicPlayer {
  public void m1() {
    S.o.pln("MusicPlayer1");
  }
}
public class TapeDeck
    extends MusicPlayer {
  public void m3() {
    S.o.pln("TapeDeck3");
  }
}
```

```
public class IPod
    extends MusicPlayer {
  public void m2() {
    S.o.pln("IPod2");
    m1();
  }
}
public class IPhone
    extends IPod {
  public void m1() {
    S.o.pln("IPhone1");
    super.m1();
  }
  public void m3() {
    S.o.pln("IPhone3");
  }
}
```

	m1	m2	m3
MusicPlayer	MP1	X	X
TapeDeck	MP1	X	TD3
IPod	MP1	IPod2 m1()	X
IPhone	IPhone1 MP1	IPod2 m1()	IPhone3

	m1	m2	m3
MusicPlayer	MP1	/	/
TapeDeck	MP1	/	TD3
IPod	MP1	IPod2 **m1**()	/
IPhone	IPhone1 MP1	IPod2 **m1**()	IPhone3

```
MusicPlayer var1 = new TapeDeck();
MusicPlayer var2 = new IPod();
MusicPlayer var3 = new IPhone();
IPod var4 = new IPhone();
Object var5 = new IPod();
Object var6 = new MusicPlayer();
```

```
var1.m1();
```
MusicPlayer1

```
var3.m1();
```
IPhone1 / MusicPlayer1

```
var4.m2();
```
IPod2 / IPhone1 / MusicPlayer1

```
var3.m2();
```
Compiler Error (CE)

```
var5.m1();
```
Compiler Error (CE)

	m1	m2	m3
MusicPlayer	MP1	/	/
TapeDeck	MP1	/	TD3
IPod	MP1	IPod2 **m1**()	/
IPhone	IPhone1 MP1	IPod2 **m1**()	IPhone3

```
MusicPlayer var1 = new TapeDeck();
MusicPlayer var2 = new IPod();
MusicPlayer var3 = new IPhone();
IPod var4 = new IPhone();
Object var5 = new IPod();
Object var6 = new MusicPlayer();
```

```
((TapeDeck) var1).m2();
```

Compiler Error (CE)

```
((IPod) var3).m2();
```

IPod2 / IPhone1 / MusicPlayer1

```
((IPhone) var2).m1();
```

Runtime Error (RE)

```
((TapeDeck) var3).m2();
```

Compiler Error (CE)

General Rule

```
PromiseType var = new ActualType();
var.method()      or      ((CastType) var).method();
```

Compile Time

```
if (involves casting) {
    check if CastType has method, if not fail with CE
} else {
    check if PromiseType has method, if not fail with CE
}
```

RunTime *(if compiles)*

```
if (involves casting) {
    check if ActualType can actually be cast to CastType,
        if not fail with RE
}
call method on ActualType
```